HOLLOW GOLF CLUB WITH COMPOSITE CORE

FIELD OF THE INVENTION

This invention relates to a hollow golf club head having a composite core, and a method of making such a head.

BACKGROUND OF THE INVENTION

The desire for perimeter weighting in a golf club iron is well known in the art. This desire stems from the fact that as the mass of the club is distributed towards the perimeter, the trajectory of the hit ball becomes more accurate, despite off-center hits away from the sweet spot of the golf club face or hitting surface. Consequently, many modern golf club irons have a rear cavity that extends towards the rear side of the face surface of the iron. The weight saved, by creating a rear cavity in the club, is re-distributed to the perimeter of the golf club head. The greater the volume of the cavity, the greater the amount of mass of metal that can be redistributed to the perimeter of the golf club head.

Conventionally, golf club heads were made from a single material, usually stainless steel for some metal woods and iron type clubs, and recently a large shift in the use of titanium for metal woods. Carbon fiber composite materials have been introduced in an effort to decrease the weight of the golf club head while subsequently increasing the club head's volume. Composite materials have been used widely to reinforce thin club faces, while providing 'feel" and in some instances vibration dampening.

Typically, in an iron club head, composite inserts are used to support the rear surface of the front face. They are generally sheets of composite attached with an adhesive. The lightweight composite allows for the face to be thin and therefore a larger face and bigger sweet spot.

It is desirable to provide a golf club that optimizes the moment of inertia (MOI) and also normalizes the ball speed over a large area of the face. Thus the ball is launched at similar speeds over a large region to create a larger sweet zone.

SUMMARY OF THE INVENTION

The present invention is directed to a golf club including a metal and composite body. The body is hollow and comprises a front face, toe section, heel section, sole, top and hosel. The metal portion of the body includes, at least, the front face and preferably includes the toe section, heel section, sole and hosel. The composite material forms the remainder of the body and includes a portion juxtaposed with the front face. Preferably, the composite is molded to abut the front face directly and provide structural support therefore.

In one embodiment of the invention, a composite core and metallic body are combined to form a hollow golf club head. The composite is used to structurally support a thin front face, and for increased Coefficient of Restitution (COR). Preferably, the front face is of a higher density and lower Young's Modulus than the composite core.

In an embodiment of the invention the front face is has a first stiffness at the center of gravity (near the center of the face) and becomes progressively more flexible away from the center of gravity. Preferably, the club is designed such that the face provides substantially uniform ball speed from hits at various locations, i.e., it provides an enlarged sweet zone. The COR across the front face varies from about 0.8 to about 0.9 across the front face. The variation in flexibility across the face may be a result of the front face structure alone, or it may result from a combination of the front face and composite core structures or the front face and composite core materials. The internal volume of the golf club iron head is about 35cc to 50cc.

An embodiment of the invention is comprised of a metal body member that may be cast, forged, stamped or made by metal injection molding. The body member is placed in a mold and a composite core is biasly inflated and expanded

against the metal body and mold by a bladder method. Preferably, the composite core is located such that the composite material is juxtaposed against portions of the metal body and mold. The mold is used as a boundary for specific regions of the club head where the metal body has an opening(s) such that the exterior of the club is partially metal and partially composite. Embodiments of the invention are provided in both hollow irons as well as metal woods.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a rear elevation view of an embodiment of the present invention showing the visible composite core.

FIG. 2 is a cross-sectional view of the invention of Fig 1 along line A—A showing the bladder molded composite core

FIG. 3 is a rear elevation view of the Fig. 1 without the composite core.

FIG. 4 is a pictorial view of the sole showing the position of a plug.

FIG. 5 is a front elevation view of FIG. 1.

FIG. 6 is a cross-sectional view of an embodiment of the invention showing a composite core assembly that was inserted by being pivoted into an opening in the club head.

FIG. 7 is a top view of a metal wood showing composite core material visual from the crown area.

FIG. 8 is a cross section view of FIG. 7 along line B—B.

DETAILED DESCRIPTION OF THE INVENTION

An embodiment of an iron golf club head **10** of the present invention is shown in FIGS. 1 to 5. The body **12** of the golf club head **10** has a metal portion having a face section **14** providing a front face **16** for striking golf balls, a top section **15**, a sole **17** having an open port **19**, a hosel **21**, a thin front region **23** of the sole **17**, and a

rear opening **25**. A sole plug **26** is inserted within the port **19**, as discussed later. The body **12** has a cavity **22** that is defined rearward of the face section **14**. A lightweight composite core **20** is biasly placed within the cavity **22**, juxtaposed against a rear surface **18** of the body **12**, to internally reinforce the body **12**, and also support the front face **16**. The metal body **12** may be cast, forged, stamped or made by metal injection molding process. Reinforcing the body **12** with the lightweight composite core **20** allows for the body **12** to be thinned down in select regions. The thinned down regions permit the mass distribution optimization (Center of Gravity and Moment of Inertia) of the club head **10**, and also stiffening the front face **16** that may be relatively flexible due to the thin structure.

The front face **16** can be made relatively thin because of the reinforcement of the composite core **20**. The thickness (t_1) of the front face **16** is preferably between about 0.04 inch to 0.12 inch, and more preferably between 0.06 inch to 0.1, while the thickness (t_2) of the composite core **20** is preferably between about 0.02 inch to 0.1 inch. The composite reinforced face can be designed to provide face flexibility characteristics that yield maximum Coefficient of Restitution (COR) values from about 0.8 to about 0.9. The COR of the club head **10** may vary across the front face **16** to normalize ball speed and provide an enlarged sweet zone for added forgiveness. Therein the COR of the club **10** of the present invention may be about 0.8 at the face center and greater than 0.8 away from the face center. Generally, the stiffness of the front face **16** is greatest at the face center, and becomes progressively more flexible away from the face center. The coefficient of restitution is obtained under test conditions, such as those specified by the USGA. The standard USGA conditions for measuring the coefficient of restitution is set forth in the USGA Procedure for Measuring the Velocity Ratio of a Club Head for Conformance to Rule 4-1e, Appendix II available from the U.S.G.A.

The club head **10** forms a hollow style club **10** with thin walls in select regions, especially the face side section **14**. The thin regions are the structurally reinforced with the lightweight composite core **20**. The composite core **20** may be made of plastic, carbon graphite or any lightweight material with a density less than 4.5 gm/cc, and may be inserted into the hollow golf club **10** in a variety of methods. While the

method of inserting the composite core **20** may vary, one example of the invention uses a well-known bladder method. This method comprises a composite core **20** being inserted into the cavity **22**, and a bladder (not shown), preferably made from latex, silicone, or similar materials, is then introduced into the composite core **20** and therein into the cavity **22**, through a port **19** (shown in FIG. 1). Preferably, the composite core **20** is located such that the composite material is juxtaposed against portions of the metal body **12** and the mold. The assembly comprises, the metal golf club body **12**, composite core **20**, and bladder. It is then positioned in a mold, which is not shown, but is used as a boundary for specific regions of the club head **10** where the metal body **12** has an opening, such as the rear opening **25**. Thus, the exterior of the resultant club head **10** is partially metal and partially composite. A source of pressurized gas, usually air, (source not shown) is introduced through the port **19** to inflate and expand the bladder, and thereby cause plies of the composite core **20** to biasly expand against the inner walls of the golf club **10** and against the internal walls of the mold. The internal walls of the tool are thus used as a boundary for a region of composite or plastic that is visible to the outside of the golf club **10**. Heat may be provided at a predetermined temperature for a selected period of time, i.e., a time sufficient to allow proper curing of the composite material. After depressurizing, the bladder may be removed through the port **19**, and the golf club head **10** may be removed from the mold. The exterior of the resultant club head **10** is partially metal body **12** and partially composite core material **20** with an internal volume between about 35cc to 50cc.

The introduction of the plug **26** in the port **19** causes the center of gravity of the club head to be lowered. Plugs **26** of varying weight can adjust the swing weight of the club to match a golfer's specifications. An embodiment of the invention used a plug **26** made from tungsten.

While embodiments of the present invention focus on irons, Figs. 7 to 8 depict a typical metal wood **50** that has been manufactured by this method and wherein composite core material **54** shows through at the crown section **52**. The hollow cavity of the metal wood **50** provides for an internal volume between about 300cc to

400cc. Fairway wood versions of this metal wood **50** have internal volumes between about 150cc to 225cc.

In another embodiment of the invention as depicted by FIG. 6, an iron type club head **40** is formed from a cast body **41** having an open section **43**, and a separately formed sub-composite core assembly **42**, which is first formed, then inserted and securely received into the cavity **22** of the club head **40**. Insertion of the assembly **42** into the cavity **22** may require an injection or compressive tool. Preferably, after it has been substantially formed and cured, the composite core assembly **42** is pinched and pivoted into the open section **43**, then it adheres to the inner wall **46**. Opening **43** is then closed by the structure of the core assembly **42**. The core assembly **42** supports a substantial portion of the front face **47** and is secured to the inner wall **46** by a layer of adhesive **45**. The composite core assembly **42** may have structural means **49** to snap-fit into position with the club head body **12**. After being positioned into place, the opening **48** around the core assembly **42** is sealed by an epoxy.

The construction of the front face **16**, as shown in FIG. 5, illustrates an example of the present invention comprising a variation in the thickness of the front face **16**. The front face **16** is preferably partitioned into oval regions, each having a progressively lower stiffness. Thus, moving away from the face center, the front face **16** decreases in stiffness and thus increases in flexibility, therein increasing the COR in that area. This design normalizes ball speed over a large range, thus improving the golf club's "forgiveness" or enlarged sweet spot. The front face **16** may be made such that it's flexibility in the face center (proximate the location of the CG) is generally stiffer than the area around the face center. The increase in COR in combination with the energy loss, that occurs from missing a direct central hit on the front face **14**, balances out to thereby give the same ball speed as a shot hit directly in line with the face center. While it is known that variable face flexibility can be achieved by making adjustments in the thickness of the front face **16**, an example of the invention accomplishes the varying of flexibility by incorporating a varying composite stiffness (via geometry or material variations).

It is believed that those skilled in the pertinent art will recognize the improved inventive concepts of this invention. And they will readily understand that while the present invention has been described in association with a preferred embodiment thereof, and other embodiments illustrated in the accompanying drawings, numerous changes, modifications and substitutions of equivalents may be made therein without departing from the spirit and scope of this invention.